semi-savage people. He has thus had the opportunity of producing a fine, original work in ethnography, his memoirs being more elaborate than the other volumes of this excellent series which we owe to the enterprise and liberality of the Government of Assam.

Previous writers have found little that is favourable in the character of the Sema, and speak of their cruelty in war, their treachery and habit of lying. But Mr. Hutton, himself an Irishman, describes them as the Irishmen of the Naga race, generous, hospitable, and frequently improvident, impulsive and cheery, if easily depressed quickly regaining their spirits, readily moved to laughter and merriment under the most unpleasant conditions, while they still preserve a strong vein of fatalism. Their physical endurance in carrying heavy loads for long distances, in bearing cold and exposure, is remarkable, and in warfare and hunting, at any rate by Naga standards, they are plucky and daring. Their women, in appearance stumpy, plain or even ugly, are cheerful, faithful wives and dutiful daughters. Their art is limited to the decoration of their dress, weapons, and the Genna posts which mark the taboo limits of their villages.

As is usually the case with semi-savage tribes, the Sema live under a rigorous system of taboos, much more restrictive than those of the Hindu caste system. This type of taboo, known as Genna, is largely regulated by the agricultural seasons, and is enforced at sowing, harvest, and other farming operations. On such occasions work is suspended and special diet with numerous other trivial restrictions is enforced. They believe in a Creator, vaguely conceived, who interferes little in the affairs of men, in spirits of the sky and of the wild, spirits which cause delirium, spoil the crops and breed strife and quarrels, the spirits of the dead which fetch the living when they die. The basis of society is not the tribe or the clan, but the village, and they have evolved an elaborate system of social law. They manufacture for their own use excellent cotton cloth, not using fibres as the Angami do. Iron work is of recent introduction and follows methods borrowed from adjoining tribes. In spite of this advancement in social and industrial culture, head-hunting, success in which entitles the hero to wear gauntlets decorated with cowry shells and a collar of pigs' tushes, prevails, and the heads of women are specially valued, probably because they are secured with difficulty, women working only near the village in time of danger.

Mr. Hutton has described this strange type of society with wide knowledge and sympathy. His book is comprehensive, well arranged and supplied with maps and illustrations. Mr. H. Balfour, who writes a foreword, does full justice to it as an ethnographical study, and he informs us that Mr. Hutton has liberally presented to the Pitt Rivers Museum the greater part of his fine collections, an important gift to his old University.

More Books on Relativity.

A Criticism of Einstein and his Problem. By W. H. V. Reade. Pp. vi + 126. (Oxford: B. Blackwell, 1922.) 4*s.* 6*d.* net.

Relativity for All. By Herbert Dingle. Pp. viii + 72. (London: Methuen and Co., Ltd., 1922.) 2*s.* net.

Einstein and the Universe: A Popular Exposition of the Famous Theory. By Charles Nordmann. Translated by Joseph M'Cabe. Pp. 185. (London: T. Fisher Unwin, Ltd., 1922.) 10*s.* 6*d.* net.

Le Principe de Relativité et la Théorie de la Gravitation. Leçons professées en 1921 et 1922 à l'École polytechnique et au Muséum d'Histoire naturelle. Par Prof. J. Becquerel. Pp. ix + 342. (Paris: Gauthier-Villars et Cie, 1922.) 25 francs.

La Théorie einsteinienne de la Gravitation: Essai de vulgarisation de la théorie. Par Prof. Gustave Mie. Ouvrage traduit de l'allemand. Pp. xi + 119. (Paris: J. Hermann, 1922.) 4·50 francs.

L'Éther actuel et ses précurseurs (simple récit). Par E. M. Lémeray. Préface de L. Lecorme. Pp. ix + 141. (Paris: Gauthier-Villars et Cie, 1922.)

Raum und Zeit im Lichte der speziellen Relativitätstheorie. Versuch eines synthetischen Aufbaus der speziellen Relativitätstheorie. Von Dr. C. Von Horvath. Pp. v + 58. (Berlin: Julius Springer, 1921.) England, 36 marks; Germany, 12 marks.

THE stream continues. Here are seven more books on relativity. It is difficult to know where to begin in commenting on such a collection. Mr. Reade's perhaps may be dismissed with a word; it ought not to have been written. Mr. Dingle's, on the other hand, is a serious little book by one who has caught the spirit of the matter. Within the limits of seventy small pages, without any mathematical symbols, he has done as well as can be expected in suggesting the various strains of thought that go to the making up of the theory. It is neither extravagant nor childish; it gives enough and not too much emphasis to illustrative analogies. The reader of this account may be assured that he is not being misled.

M. Nordmann's work, to which Viscount Haldane contributes a preface, is a much more ambitious production than that of Mr. Dingle and calls for more lengthy comment. To quote from the preface:

"The Latin capacity for eliminating abstractness from the description of facts is everywhere apparent. . . . This book could hardly have been written by an Englishman. The difficulty in his way would have been one as much of spirit as of letter. It is the lucidity of the French author, in combination with his own gift of expression, that has made it possible for the translator to succeed so well in overcoming the obstacles to giving the exposition in our own tongue this book contains. The rendering seems to me, after reading the book both in French and in English, admirable."

The book is certainly readable. The language is not only clear, but also picturesque. "Einstein may be a treasure, but there is a fearsome troop of mathematical reptiles keeping inquisitive folk away from it. Let us drive them off with the whip of simple terminology, and approach the splendour of Einstein's theory." This is the author's intention, like that of many others; how does he succeed?

In the first two chapters we may admit a considerable success. Here due recognition is given to the valuable work done by Poincaré in preparing the minds of physicists for the theory by his insistence on the relativity of space. The reader is brought to the point of seeing the confusion wrought by the unexpected result of the Michelson-Morley experiment.

At the third chapter the author begins to feel the excitement of Einstein's new thoughts, and gives us a version of the explanation advanced in 1905 of the true significance of the Fitzgerald contraction-hypothesis. With the gesture of a conjurer he produces a "simple" version of Einstein's argument, remarking, however, that its elementary simplicity has not been attained without difficulty. Unfortunately the explanation advanced has nothing whatever to do with the argument of Einstein or the Fitzgerald hypothesis, but refers to the first order effect which would arise if the old theory were true. Later in the chapter the footnote giving as the best definition of the second, "the time which light takes to cover 186,000 miles in empty space, far from any strong gravitational field" suggests again quite a wrong view to the unwary and inexperienced reader. In spite, however, of these inaccuracies the writer does convey something of the impression of the insufficiency of the old absolute time and space ideas, and describes the situation thus: "We have before our eyes merely a battlefield strewn with corpses and ruins." "Time and space lie, torn and crumbled, among the rubbish of ancient theories."

Now comes the task of describing in "simple terminology" the work of reconstruction. The reader must judge whether the following is simpler than a brief algebraic equation: "The distance in time and the distance in space are numerically to each other as the hypotenuse and another side of a rectangular triangle are to the third side, which remains invariable. Taking this third side for base, the other two will describe above it, a triangle more or less elevated according as the velocity of the observer is more or less reduced. This fixed base is a quantity independent of the velocity. It is this which Einstein has called the '*Interval*' of events." A few lines later we read that this interval is the "sole perceptible part of the real. Apart from it there is nothing we can know." With this the writer passes on to the next chapter. Here the mechanics arising out of the restricted principle of relativity is described clearly and without rhetoric.

We have now to see how the author deals with the generalised relativity and its consequences. If the reader has digested the idea of interval so rawly presented to him in the early chapter, and has not the quickness to perceive that this has not been extended to the generalised theory, he may get a general impression from the next two chapters which is of the right type, but which again is far from accurate in detail. It appears from the account given that the only new feature in this stage is the introduction of gravitation. Not a word is said about the application of the general doctrine that all physical laws must have a form which is independent of the arbitrary choice of variables in the four-dimensional continuum. The mathematical reptiles are certainly driven off, and the treasure is not only left unguarded but it disappears. What is left is not the genuine article. Here again there are inaccurate statements, *e.g.* "the universe is not Euclidean because in it light does not travel in a straight line."

It is no pleasure to write thus critically of a valiant attempt to bring this theory into a form suitable for the layman. It is a supremely difficult task that is being attempted by so many writers. M. Nordmann is well equipped in many ways for it. But he has fallen into the very common error of supposing that the essential truth can be given while omitting the demand for concentrated thinking on vital details. The world suffers far too much from loose thinking already. Vague generalisations, misleading analogies, superficial manifestations are made to do duty for precise statements, logical reasoning, and fundamental principles. It is not necessarily true that mathematical skill is the only way of approach to an understanding of Einstein's fundamental ideas. But it is certain that if such an understanding is to be reached it can only be by going down to a patient analysis of our own preconceived notions until we find them insufficient. Einstein's success has come from a deep-rooted conviction that those thinkers were right who would not admit that a point in empty space could be labelled "stationary" or "moving uniformly in a straight line." He followed the logic of his conviction and achieved fame. It was accuracy and honesty of thought which carried him through.

Prof. Becquerel gives us a text-book of the whole matter for those who are prepared to go into the complete mathematical presentation. There is nothing original; it is a plain and unvarnished account of the theory as it stands, including the generalisations of Eddington and Weyl. We may note that the author adopts the general conclusion that the gravitational field is the manifestation of the non-Euclidean character of the structure of the Universe, and that mechanics and physics are reduced to geometry. Is it not time that this statement should be examined more carefully? It suggests that the cart is pulling the horse and that the concrete arises out of the abstract, the known out of the unknown. When the physicist lapses into metaphysics he is apt to leave his terms undefined.

Of the remaining books before us we may briefly say that Prof. Mie's is a French translation of a German pamphlet recently noticed in these columns, that M. Lémeray traces the history of the rise and fall and ultimate extinction (as he seems to consider it) of the idea of the "ether," and that Dr. von Horvath has thought it well to try to give a new presentation of the restricted principle of relativity.

E. Cunningham.

Principles of Spectacle Design.

Handbuch der gesamten Augenheilkunde. Begründet von A. Graefe und Th. Saemisch, fortgeführt von C. Hess. Herausgegeben von Th. Axenfeld und A. Elschnig. Dritte, neubearbeitete Auflage. *Die Brille als optisches Instrument.* Von Prof. Dr. M. von Rohr. Dritte Auflage. Pp. xiv + 254. (Berlin: J. Springer, 1921.) In Germany, 66 marks; in England, 132 marks.

SINCE the first edition of this work appeared ten years ago, the design of spectacles has undergone important developments which are attributed by the author to the increased competition of large specialist manufacturers, to the interest of ophthalmologists and technical scientific workers, and to recent war experience.

The work is worthily dedicated to Allvar Gullstrand, upon whose optical treatment of the subject the theoretical portions are based, and more particularly those sections concerned with the eye in motion. It deals in a thorough and comprehensive manner with the comparatively simple geometrical principles involved in the design of spectacles for the correction of abnormal vision, but, as is clearly stated in the preface, it does not enter the sphere of the optical computer to whom the practical design is entrusted.

Those who are interested in the theoretical problems of spectacle design will find in this work a clear exposition of most aspects of the subject. The formulæ as well as the diagrams can be relied upon, as they are particularly free from errors. An introductory section deals with spectacles of various materials for special purposes. Section I. is devoted to anastigmatic lenses for both fixed and moving eyes. Section II. deals with astigmatic lenses, under which are included the various toric forms and combinations. In Section III. chromatic aberrations are considered, and apparent aberrations in the image space resulting from vision through spectacles are discussed in the concluding section. Although excellent source, name, and subject indexes are provided, there is unfortunately no index of the symbols employed. The systematic historical index of the first edition has been dispensed with, as the information is included under the various subject headings.

Nearly one-half of the text is devoted to historical references which increase the general interest of the work. As the author states in his preface, the desire to recognise the true inventor lies close to his heart. The task is a difficult one, and, if the author has failed in some respects, it may be attributed to a too ready use of German sources of information. The historical notes do not extend much beyond 1917, although, according to the title-page, the edition dated 1921 is stated to have been newly revised. Indeed, there is only one reference as recent as 1920. An English author is pilloried (p. 114) for the absurd accuracy of certain numerical data, but the author himself, in many instances records to within 1/1000 mm. ocular dimensions that are comparatively indefinite.

There is a tendency throughout the work to sacrifice clearness to generality. Spectacles, for example, are inadequately defined as "optical instruments that can be carried continuously before the eyes," the object being not to exclude extreme cases such as protective glasses for stone-hewers, spectacles for drivers, and those in which use is made of mica, horn, and other substances. But the reader will find more in this book by Dr. M. von Rohr for warm approval rather than for criticism.

James Weir French.

Our Bookshelf.

A Manual of Determinative Mineralogy. By Prof. J. Volney Lewis. Third, revised and enlarged edition. Pp. v + 298. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1921.) 16*s*. 6*d*. net.

We have here an excellent guide to the recognition of mineral species. It is not intended to supersede the use of a standard work on mineralogy, but to train